Package 'asa'

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Title AI Search Agent for Large-Scale Research Automation

Version 0.1.0

Description Provides an LLM-powered research agent for performing AI search tasks at large scales. Uses a ReAct (Reasoning + Acting) agent pattern with web search capabilities via DuckDuckGo and Wikipedia. Implements DeepAgent-style memory folding for context management. The agent is built on 'LangGraph' and supports multiple LLM backends including 'OpenAI', 'Groq', and 'xAI'.

URL https://github.com/cjerzak/asa-software

BugReports https://github.com/cjerzak/asa-software/issues

Depends R (>= 4.0.0)

License GPL-3

Encoding UTF-8

LazyData false

Imports reticulate (>= 1.28),
jsonlite,
rlang

Suggests testthat (>= 3.0.0),
knitr,
rmarkdown,
future,
future.apply,
dplyr

VignetteBuilder knitr

RoxygenNote 7.3.3

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SystemRequirements Python (>= 3.11), Conda, Tor (optional, for anonymous searching)

Contents

`as.data.frame.asa_result` *Convert asa_result to Data Frame*

Description

Convert asa_result to Data Frame

Usage

```
## S3 method for class 'asa_result'
as.data.frame(x, ...)
```

Arguments

`x`	An asa_result object
`...`	Additional arguments (ignored)

Value

A single-row data frame

asa_agent *Constructor for asa_agent Objects*

Description

Creates an S3 object representing an initialized ASA search agent.

Usage

```
asa_agent(python_agent, backend, model, config)
```

Arguments

python_agent	The underlying Python agent object
backend	LLM backend name (e.g., "openai", "groq")
model	Model identifier
config	Agent configuration list

Value

An object of class `asa_agent`

asa_response *Constructor for asa_response Objects*

Description

Creates an S3 object representing an agent response.

Usage

```
asa_response(
  message,
  status_code,
  raw_response,
  trace,
  elapsed_time,
  fold_count,
  prompt
)
```

Arguments

message	The final response text
status_code	Status code (200 = success, 100 = error)
raw_response	The full Python response object
trace	Full text trace of agent execution
elapsed_time	Execution time in minutes
fold_count	Number of memory folds performed
prompt	The original prompt

Value

An object of class `asa_response`

`asa_result` *Constructor for asa_result Objects*

Description

Creates an S3 object representing the result of a research task.

Usage

```
asa_result(prompt, message, parsed, raw_output, elapsed_time, status)
```

Arguments

`prompt`	The original prompt
`message`	The agent's response text
`parsed`	Parsed output (list or NULL)
`raw_output`	Full agent trace
`elapsed_time`	Execution time in minutes
`status`	Status ("success" or "error")

Value

An object of class `asa_result`

`build_backend` *Build the Python Backend Environment*

Description

Creates a conda environment with all required Python dependencies for the asa search agent, including LangChain, LangGraph, and search tools.

Usage

```
build_backend(conda_env = "asa_env", conda = "auto", python_version = "3.13")
```

Arguments

`conda_env`	Name of the conda environment (default: "asa_env")
`conda`	Path to conda executable (default: "auto")
`python_version`	Python version to use (default: "3.13")

Details

This function creates a new conda environment and installs the following Python packages:

- langchain_groq, langchain_community, langchain_openai
- langgraph
- ddgs (DuckDuckGo search)
- selenium, primp (browser automation)
- beautifulsoup4, requests
- fake_headers, httpx
- pysocks, socksio (proxy support)

Value

Invisibly returns NULL; called for side effects.

Examples

```
## Not run:
# Create the default environment
build_backend()

# Create with a custom name
build_backend(conda_env = "my_asa_env")

## End(Not run)
```

---

build_prompt *Build a Task Prompt from Template*

Description

Creates a formatted prompt by substituting variables into a template.

Usage

```
build_prompt(template, ...)
```

Arguments

`template`	A character string with placeholders in the form `{variable_name}`
`...`	Named arguments to substitute into the template

Value

A formatted prompt string

Examples

```
## Not run:
prompt <- build_prompt(
  template = "Find information about {{name}} in {{country}} during {{year}}",
  name = "Marie Curie",
  country = "France",
  year = 1903
)

## End(Not run)
```

---

check_backend *Check Python Environment Availability*

Description

Checks if the required Python environment and packages are available.

Usage

```
check_backend(conda_env = "asa_env")
```

Arguments

conda_env	Name of the conda environment to check

Value

A list with components:

- available: Logical, TRUE if environment is ready
- conda_env: Name of the environment checked
- python_version: Python version if available
- missing_packages: Character vector of missing packages (if any)

Examples

```
## Not run:
status <- check_backend()
if (!status$available) {
  build_backend()
}

## End(Not run)
```

`configure_search` *Configure Python Search Parameters*

Description

Sets global configuration values for the Python search module. These values control timeouts, retry behavior, and result limits.

Usage

```
configure_search(
  max_results = NULL,
  timeout = NULL,
  max_retries = NULL,
  retry_delay = NULL,
  backoff_multiplier = NULL,
  captcha_backoff_base = NULL,
  page_load_wait = NULL,
  conda_env = "asa_env"
)
```

Arguments

`max_results`	Maximum number of search results to return (default: 10)
`timeout`	HTTP request timeout in seconds (default: 15)
`max_retries`	Maximum retry attempts on failure (default: 3)
`retry_delay`	Initial delay between retries in seconds (default: 2)
`backoff_multiplier`	Multiplier for exponential backoff (default: 1.5)
`captcha_backoff_base`	Base multiplier for CAPTCHA backoff (default: 3)
`page_load_wait`	Wait time after page load in seconds (default: 2)
`conda_env`	Name of the conda environment (default: "asa_env")

Value

Invisibly returns a list with the current configuration

Examples

```
## Not run:
# Increase timeout for slow connections
configure_search(timeout = 30, max_retries = 5)

# Get more results
configure_search(max_results = 20)

## End(Not run)
```

configure_search_logging *Configure Python Search Logging Level*

Description

Sets the logging level for the Python search module. This controls how much diagnostic output is produced during web searches.

Usage

```
configure_search_logging(level = "WARNING", conda_env = "asa_env")
```

Arguments

level	Log level: "DEBUG", "INFO", "WARNING" (default), "ERROR", or "CRITICAL"
conda_env	Name of the conda environment (default: "asa_env")

Details

Log levels from most to least verbose:

- DEBUG: Detailed diagnostic information for debugging
- INFO: General operational information
- WARNING: Indicates something unexpected but not an error (default)
- ERROR: Serious problems that prevented an operation
- CRITICAL: Very serious errors

Value

Invisibly returns the current logging level

Examples

```
## Not run:
# Enable verbose debugging output
configure_search_logging("DEBUG")

# Run a search (will show detailed logs)
result <- run_task("What is the population of Tokyo?", agent = agent)

# Disable verbose output
configure_search_logging("WARNING")

## End(Not run)
```

extract_agent_results *Extract Structured Data from Agent Traces*

Description

Parses raw agent output to extract search snippets, Wikipedia content, URLs, and JSON data. This is the main function for post-processing agent traces.

Usage

```
extract_agent_results(raw_output)
```

Arguments

raw_output	Raw output string from agent invocation (the trace field from an asa_response object)

Value

A list with components:

- search_snippets: Character vector of search result content
- search_urls: Character vector of URLs from search results
- wikipedia_snippets: Character vector of Wikipedia content
- json_data: Extracted JSON data as a list (if present)

Examples

```
## Not run:
response <- run_agent("Who is the president of France?", agent)
extracted <- extract_agent_results(response$trace)
print(extracted$search_snippets)

## End(Not run)
```

extract_search_snippets *Extract Search Snippets by Source Number*

Description

Extracts content from Search tool messages in the agent trace.

Usage

```
extract_search_snippets(text)
```

Arguments

text	Raw agent trace text

Value

Character vector of search snippets, ordered by source number

Examples

```
## Not run:
snippets <- extract_search_snippets(response$trace)

## End(Not run)
```

`extract_urls` *Extract URLs by Source Number*

Description

Extracts URLs from Search tool messages in the agent trace.

Usage

```
extract_urls(text)
```

Arguments

`text`	Raw agent trace text

Value

Character vector of URLs, ordered by source number

Examples

```
## Not run:
urls <- extract_urls(response$trace)

## End(Not run)
```

`extract_wikipedia_content`
Extract Wikipedia Content

Description

Extracts content from Wikipedia tool messages in the agent trace.

Usage

```
extract_wikipedia_content(text)
```

Arguments

text	Raw agent trace text

Value

Character vector of Wikipedia snippets

Examples

```
## Not run:
wiki <- extract_wikipedia_content(response$trace)

## End(Not run)
```

---

get_agent *Get the Current Agent*

Description

Returns the currently initialized agent, or NULL if not initialized.

Usage

```
get_agent()
```

Value

An asa_agent object or NULL

Examples

```
## Not run:
agent <- get_agent()
if (is.null(agent)) {
  agent <- initialize_agent()
}

## End(Not run)
```

get_tor_ip *Get External IP via Tor*

Description

Retrieves the external IP address as seen through Tor proxy.

Usage

```
get_tor_ip(proxy = "socks5h://127.0.0.1:9050")
```

Arguments

proxy	Tor proxy URL

Value

IP address string or NA on failure

Examples

```
## Not run:
ip <- get_tor_ip()
message("Current Tor IP: ", ip)

## End(Not run)
```

initialize_agent *Initialize the ASA Search Agent*

Description

Initializes the Python environment and creates the LangGraph agent with search tools (Wikipedia, DuckDuckGo). The agent can use multiple LLM backends and supports DeepAgent-style memory folding.

Usage

```
initialize_agent(
  backend = "openai",
  model = "gpt-4.1-mini",
  conda_env = "asa_env",
  proxy = "socks5h://127.0.0.1:9050",
  use_memory_folding = TRUE,
  memory_threshold = 4L,
  memory_keep_recent = 2L,
  rate_limit = 0.2,
  timeout = 120L,
  verbose = TRUE
)
```

Arguments

backend	LLM backend to use. One of: "openai", "groq", "xai", "exo", "openrouter"
model	Model identifier (e.g., "gpt-4.1-mini", "llama-3.3-70b-versatile")
conda_env	Name of the conda environment with Python dependencies
proxy	SOCKS5 proxy URL for Tor (default: "socks5h://127.0.0.1:9050"). Set to NULL to disable proxy.
use_memory_folding	Enable DeepAgent-style memory compression (default: TRUE)
memory_threshold	Number of messages before folding triggers (default: 4)
memory_keep_recent	Number of recent messages to preserve after folding (default: 2)
rate_limit	Requests per second for rate limiting (default: 0.2)
timeout	Request timeout in seconds (default: 120)
verbose	Print status messages (default: TRUE)

Details

The agent is created with two tools:

- Wikipedia: For looking up encyclopedic information
- DuckDuckGo Search: For web searches with a 4-tier fallback system (PRIMP -> Selenium -> DDGS library -> raw requests)

Memory folding (enabled by default) compresses older messages into a summary to manage context length in long conversations, following the DeepAgent paper.

Value

An object of class `asa_agent` containing the initialized agent and configuration.

API Keys

The following environment variables should be set based on your backend:

- OpenAI: `OPENAI_API_KEY`
- Groq: `GROQ_API_KEY`
- xAI: `XAI_API_KEY`
- OpenRouter: `OPENROUTER_API_KEY`

OpenRouter Models

When using the `"openrouter"` backend, model names must be in `provider/model-name` format. Examples:

- `"openai/gpt-4o"`
- `"anthropic/claude-3-sonnet"`
- `"google/gemma-2-9b-it:free"`
- `"meta-llama/llama-3-70b-instruct"`

See https://openrouter.ai/models for available models.

See Also

run_agent, run_task

Examples

```
## Not run:
# Initialize with OpenAI
agent <- initialize_agent(
  backend = "openai",
  model = "gpt-4.1-mini"
)

# Initialize with Groq and custom settings
agent <- initialize_agent(
  backend = "groq",
  model = "llama-3.3-70b-versatile",
  use_memory_folding = FALSE,
  proxy = NULL  # No Tor proxy
)

# Initialize with OpenRouter (access to 100+ models)
agent <- initialize_agent(
  backend = "openrouter",
  model = "anthropic/claude-3-sonnet"  # Note: provider/model format
)

## End(Not run)
```

---

is_tor_running *Check if Tor is Running*

Description

Checks if Tor is running and accessible on the default port.

Usage

```
is_tor_running(port = 9050L)
```

Arguments

port	Port number (default: 9050)

Value

Logical indicating if Tor appears to be running

Examples

```
## Not run:
if (!is_tor_running()) {
  message("Start Tor with: brew services start tor")
}

## End(Not run)
```

`print.asa_agent` *Print Method for asa_agent Objects*

Description

Print Method for asa_agent Objects

Usage

```
## S3 method for class 'asa_agent'
print(x, ...)
```

Arguments

`x`	An asa_agent object
`...`	Additional arguments (ignored)

Value

Invisibly returns the object

`print.asa_response` *Print Method for asa_response Objects*

Description

Print Method for asa_response Objects

Usage

```
## S3 method for class 'asa_response'
print(x, ...)
```

Arguments

`x`	An asa_response object
`...`	Additional arguments (ignored)

Value

Invisibly returns the object

print.asa_result *Print Method for asa_result Objects*

Description

Print Method for asa_result Objects

Usage

```
## S3 method for class 'asa_result'
print(x, ...)
```

Arguments

x	An asa_result object
...	Additional arguments (ignored)

Value

Invisibly returns the object

process_outputs *Process Multiple Agent Outputs*

Description

Processes a data frame of raw agent outputs, extracting structured data.

Usage

```
process_outputs(df, parallel = FALSE, workers = 10L)
```

Arguments

df	Data frame with a 'raw_output' column containing agent traces
parallel	Use parallel processing
workers	Number of workers

Value

The input data frame with additional extracted columns: search_count, wiki_count, and any JSON fields found

reset_agent *Reset the Agent*

Description

Clears the initialized agent state, forcing reinitialization on next use. Also closes any open HTTP clients to prevent resource leaks.

Usage

```
reset_agent()
```

Value

Invisibly returns NULL

rotate_tor_circuit *Rotate Tor Circuit*

Description

Requests a new Tor circuit by restarting the Tor service.

Usage

```
rotate_tor_circuit(method = c("brew", "systemctl", "signal"), wait = 12L)
```

Arguments

method	Method to restart: "brew" (macOS), "systemctl" (Linux), or "signal"
wait	Seconds to wait for new circuit (default: 12)

Value

Invisibly returns NULL

Examples

```
## Not run:
rotate_tor_circuit()

## End(Not run)
```

run_agent *Run the ASA Agent with a Custom Prompt*

Description

Invokes the search agent with an arbitrary prompt, returning the full agent trace and response. This is the low-level function for running the agent; for structured task execution, use run_task.

Usage

```
run_agent(prompt, agent = NULL, recursion_limit = NULL, verbose = FALSE)
```

Arguments

prompt	The prompt to send to the agent
agent	An asa_agent object from initialize_agent, or NULL to use/create the default agent
recursion_limit	Maximum number of agent steps (default: 100 for memory folding, 20 otherwise)
verbose	Print status messages (default: FALSE)

Value

An object of class asa_response containing:

- message: The final response text
- status_code: 200 for success, 100 for error
- raw_response: The full Python response object
- trace: Full text trace of agent execution
- elapsed_time: Execution time in minutes
- fold_count: Number of memory folds (if memory folding enabled)

See Also

initialize_agent, run_task

Examples

```
## Not run:
# Run with a custom prompt
agent <- initialize_agent()
result <- run_agent(
  prompt = "Who was the 44th president of the United States?",
  agent = agent
)
print(result$message)

## End(Not run)
```

run_agent_batch *Run Agent in Batch Mode*

Description

Runs the agent on multiple prompts, optionally in parallel.

Usage

```
run_agent_batch(
  prompts,
  agent = NULL,
  parallel = FALSE,
  workers = 4L,
  progress = TRUE
)
```

Arguments

prompts	Character vector of prompts
agent	An asa_agent object
parallel	Use parallel processing (requires future.apply package)
workers	Number of parallel workers (default: 4)
progress	Show progress bar (default: TRUE)

Value

A list of asa_response objects

Examples

```
## Not run:
prompts <- c(
  "What is the population of Tokyo?",
  "What is the population of New York?"
)
results <- run_agent_batch(prompts, agent)

## End(Not run)
```

run_task *Run a Structured Task with the Agent*

Description

Executes a research task using the AI search agent with a structured prompt and returns parsed results.

Usage

```
run_task(prompt, output_format = "text", agent = NULL, verbose = FALSE)
```

Arguments

prompt	The task prompt or question for the agent to research
output_format	Expected output format. One of: "text" (raw response), "json" (parse as JSON), or a character vector of field names to extract
agent	An asa_agent object from initialize_agent, or NULL to use the currently initialized agent
verbose	Print progress messages (default: FALSE)

Details

This function provides a high-level interface for running research tasks. For simple text responses, use output_format = "text". For structured outputs, use output_format = "json" or specify field names to extract.

Value

An object of class asa_result with components:

- prompt: The original prompt
- message: The agent's response text
- parsed: Parsed output (if output_format specified)
- raw_output: Full agent trace
- elapsed_time: Execution time in minutes
- status: "success" or "error"

See Also

initialize_agent, run_agent, run_task_batch

Examples

```
## Not run:
# Initialize agent first
agent <- initialize_agent(backend = "openai", model = "gpt-4.1-mini")

# Simple text query
result <- run_task(
  prompt = "What is the capital of France?",
  output_format = "text",
  agent = agent
)
print(result$message)

# JSON structured output
result <- run_task(
  prompt = "Find information about Albert Einstein and return JSON with
            fields: birth_year, death_year, nationality, field_of_study",
  output_format = "json",
  agent = agent
)
print(result$parsed)

## End(Not run)
```

`run_task_batch` *Run Multiple Tasks in Batch*

Description

Executes multiple research tasks, optionally in parallel.

Usage

```
run_task_batch(
  prompts,
  output_format = "text",
  agent = NULL,
  parallel = FALSE,
  workers = 4L,
  progress = TRUE
)
```

Arguments

`prompts`	Character vector of task prompts, or a data frame with a 'prompt' column
`output_format`	Expected output format (applies to all tasks)
`agent`	An asa_agent object
`parallel`	Use parallel processing
`workers`	Number of parallel workers
`progress`	Show progress messages

Value

A list of asa_result objects, or if prompts was a data frame, the data frame with result columns added

Examples

```
## Not run:
prompts <- c(
  "What is the population of Tokyo?",
  "What is the population of New York?",
  "What is the population of London?"
)
results <- run_task_batch(prompts, agent = agent)

## End(Not run)
```

---

summary.asa_agent *Summary Method for asa_agent Objects*

Description

Summary Method for asa_agent Objects

Usage

```
## S3 method for class 'asa_agent'
summary(object, ...)
```

Arguments

object	An asa_agent object
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

---

summary.asa_response *Summary Method for asa_response Objects*

Description

Summary Method for asa_response Objects

Usage

```
## S3 method for class 'asa_response'
summary(object, show_trace = FALSE, ...)
```

Arguments

object	An asa_response object
show_trace	Include full trace in output
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

---

summary.asa_result *Summary Method for asa_result Objects*

Description

Summary Method for asa_result Objects

Usage

```
## S3 method for class 'asa_result'
summary(object, ...)
```

Arguments

object	An asa_result object
...	Additional arguments (ignored)

Value

Invisibly returns a summary list

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